             IAB Recommendations for the Development of
               Internet Network Management Standards

Status of this Memo

   This memo is intended to convey to the Internet community and other
   interested parties the recommendations of the Internet Activities
   Board (IAB) for the development of network management protocols for
   use in the TCP/IP environment. The memo does NOT, in and of itself,
   define or propose an Official Internet Protocol. It does reflect,
   however, the policy of the IAB with respect to further network
   management development in the short and the long term. Distribution
   of this memo is unlimited.

Background

   At the IAB meeting on 21 March 88 in videoconference, the report of
   the Ad Hoc Network Management Review Committee was reviewed. The
   recommendations of the committee were endorsed by the IAB and
   direction given to the chairman of the Internet Engineering Task
   Force to take the necessary steps to implement the recommendations.

   The IAB expressed its gratitude for the efforts of the HEMS, SNMP and
   CMIP/CMIS working groups and urged that parties with technical
   interest in the outcome of the network management working groups
   convey their ideas and issues to the relevant working group chairmen.

   The IETF chairman was directed to form two new working groups, one of
   which would be responsible for the further specification and
   definition of elements to be included in the Management Information
   Base (MIB). The other would be responsible for defining extensions
   to the Simple Network Management Protocol to accommodate the short-
   term needs of the network vendor and operator communities. The
   longer-term needs of the Internet community are to be met using the
   ISO CMIS/CMIP framework as a basis. A working group of the IETF
   exists for this work and would continue its work, coordinating with
   the two new groups and reporting to the IETF chairman for guidance.

   The output of the MIB working group is to be provided to both the
   SNMP working group and the CMIS/CMIP ["Netman"] working group so as
   to assure compatibility of monitored items for both network
   management frameworks.

Specific Recommendations

     The IAB recommends that the Simple Network Management Protocol be
     adopted as the BASIS for network management in the short-term.
     Extensions may be required to the existing SNMP specification to
     accommodate additional data types or to deal with functional or
     performance issues arising as multiple SNMP implementations are
     deployed and applied, especially in multi-vendor applications.

     The SNMP working group constituted by the IETF is charged with
     considering requirements not met by the present SNMP definition,
     defining extensions, if necessary, to accommodate these needs, and
     preparing revisions of the SNMP specifications to address any new
     extensions.

     The IAB urges the working group to be extremely sensitive to the need
     to keep SNMP simple, to work quickly to come to concensus on any
     revisions needed and to promulgate expeditiously the results of its
     work in one or more RFCs within the next 90 days. The IETF chairman
     is responsible for resolving disagreements arising if they cannot be
     resolved within the working group and is instructed to escalate
     problems quickly to the IAB should resolution not be forthcoming.

     The IAB further recommends that the MIB working group begin its work
     equally expeditiously, taking as its starting inputs the MIB
     definitions found in the existing High-Level Entity Management
     Systems (HEMS) RFC-1024, the SNMP IDEA-11, and CMIS/CMIP IDEAs.

     It is the intention of the IAB that the MIB definitions be applied
     both to the SNMP system in the short term and CMIS/CMIP for TCP/IP in
     the longer term. The three working groups will have to coordinate
     their efforts carefully to achieve these objectives:

          1. Rapid convergence and definition for SNMP.

          2. Rapid convergence and definition for the TCP/IP MIB.

          3. Provision for transitioning from SNMP to CMIP/CMIS.

          4. Early demonstration of the CMIP/CMIS capability using the
             TCP/IP MIB.

     The IAB remains extremely interested in progress towards these goals
     and intends to have representation, whenever possible, in the various
     working group and IETF plenary activities.

REPORT OF THE AD HOC NETWORK MANAGEMENT REVIEW COMMITTEE

Edited by Vinton Cerf, Chairman

March 1988

EXECUTIVE SUMMARY

On 29 February 88, an ad hoc committee was convened to review the
network management options for the Internet in particular and the
TCP/IP protocol suite in general. This meeting was called at the
request of the Internet Activities Board in the course of exercising
its responsibilities to the Federal Research Internet Coordinating
Council (FRICC) and by the MITRE Corporation as a consequence of its
work for the U.S. Air Force on the ULANA project.

At the conclusion of the one day meeting, it was agreed that the
following recommendations be forwarded to the Internet Activities
Board chairman, Dr. David C. Clark, for consideration at the next IAB
meeting scheduled for 21 March:

   1. In the short term, the Internet community should adopt and
   adapt the Simple Network Management Protocol (SNMP) for use as the
   basis of common network management throughout the system.

   (Rationale: The software is available and in operation.)

   2. In the longer term, the Internet research community and the
   vendors should develop, deploy and test a network management
   system based on the International Standards Organization (ISO)
   Common Management Information Services/Common Management
   Information Protocol (CMIS/CMIP).

   (Rationale: The Internet community can take the high ground in
   protocol development by virtue of the experimental environment in
   which it can operate. Recommendations to the ISO from this
   community, the IAB and the vendors will carry great weight if they
   are in the language of the ISO common network management system
   and if they are rooted in actual experience with implementation
   and use in the field.)

   3. Responsibility for the SNMP effort should be placed in the
   hands of an IETF task force.

   (Rationale: Eliminate vendor-specific bias or control over the
   SNMP and its evolution and harmonize inputs from the Internet
   community.)

4. As a high priority effort, define an extended Management
Information Base (MIB) for SNMP and TCP/IP CMIP to bring them into
closer conformance with the MIB defined for the experimental
HighLevel Entity Management System (HEMS).

(Rationale: The HEMS effort produced a very thorough and widely-
discussed set of elements to monitor, along with definitions of
the semantics of these elements. The current SNMP definitions are
more restricted and the CMIP definitions less precise.
Implementation of SNMP in a timely and useful fashion through the
Internet cannot be satisfactorily completed without such a
definition of information elements in hand.)

The ad hoc committee therefore recommends immediate action by the
IAB on all four of these points. It should be noted that this
resolution would not have been possible in such a timely way
without the statesman-like efforts of Craig Partridge who, at the
end of the day, recommended that the HEMS effort be withdrawn from
consideration so as to pave the way for an Internet-wide
agreement. In consideration of this unselfish act, the ad hoc
committee urges the IAB to approve the recommendations above and
to instruct the IETF to move quickly to accept and act on the SNMP
items requiring completion.

1. INTRODUCTION

During its development history, the community of researchers,
developers, implementors and users of the DARPA/DoD TCP/IP protocol
suite have experimented with a wide range of protocols in a variety
of different networking environments. The Internet has grown,
especially in the last few years, as a result of the widespread
availability of software and hardware supporting this system. The
scaling of the size and scope of the Internet and increased use of
its technology in commercial applications has underscored for
researchers, developers and vendors the need for a common network
management framework within which TCP/IP products can be made to
work.

In recognition of this need, several efforts were started to develop
network management concepts which might be applied to the Internet
and to the internet technology in general. Three of these efforts
had made sufficient progress by the end of 1987 that it became clear
that some choices had to be made or the community would find itself
with a set of incompatible network management tools. These efforts
included the High-Level Entity Management System (HEMS), the Simple
Gateway Monitoring Protocol (SGMP) and the Common Management
Information Service/Protocol.

The latter is an ISO initiative which was adapted to Internet use in
a vendor-initiated effort. The HEMS work was carried out in the
context of the Gateway Monitoring group of the Internet Engineering
Task Force. The SGMP effort was carried out largely in the practical
context of the NYSERNET and SURAnet regional networks which needed
network management facilities to operate satisfactorily.

Independent of the general Internet situation and requirements, the
U.S. Air Force has been pursuing a Universal Local Area Network
Architecture (ULANA) for its own use. The principal agent for the
development of the ULANA specifications is the MITRE Corporation.
Faced with several long and short term network management options,
the MITRE ULANA specification team initiated an effort with
substantial vendor participation called the NETMAN working group.

It was against this fabric of various options that the IAB appointed
a chairman to convene a review committee to discuss these various
options and to make recommendations on long and short term choices.
The MITRE Corporation co-sponsored this work to further its aims in
the specification of the ULANA design.

Reference material listed at the end of this report was provided in
advance of the meeting.

2. DISCUSSION

Rather than attempting to produce minutes of the meeting, this
section summarizes in very high level terms the substance of the
discussion which took place during most of the meeting. Presentation
viewgraphs can be made available to IAB/FRICC members interested in
their contents.

The agenda was followed fairly closely with the technical
presentations made in the order suggested: HEMS, SGMP, CMIP/CMIS.

The HEMS effort has established a benchmark for other network
management work in the sense that it took a comprehensive conceptual
view of the problem and went into considerable detail on the design
of the underlying management information database, the mechanics of
access to and reporting of information, considerations of scaling and
performance (e.g., Query Language vs Remote Procedure Call style),
definition of information required and so on. HEMS has been
implemented in an experimental version from which some encouraging
performance measurements were taken. Serious vendor interest in this
protocol was expressed by Cisco Systems and implementation efforts
were under way as of the meeting.

The SGMP effort, though somewhat less documented, was rooted in a

practical need for network management tools for the NYSERNET,
SURAnet, and, by extension, other components of the Internet.
Implementations of it exist, in its RFC-1028 form (probably with some
experimental extensions based on experience gained from the initial
work), and are in use today. Serious vendor support for this work is
found at Proteon and, more recently, in the NSFNET effort by MERIT,
IBM and MCI, specifically in the IBM Network Switching System (NSS)
nodes. Applications running above SGMP exist and provide useful
monitoring information, presented in easily grasped form.

The ISO CMIS/CMIP effort, voluminously documented, has had almost no
implementation as yet. Reports from Unisys/SDC about an experimental
implementation were heard at the meeting. There is substantial
momentum in the international community for the adoption of this
service and protocol suite for network management. The Draft
Proposal is out for its second ballot (it failed to make Draft
International Standard on its first ballot). There is vocal vendor
support for this work, based on the premise that ultimately the ISO
protocol suite will propagate and the vendors must support it.

In general, all of the network management proposals make use of the
Abstract Syntax Notation 1 (ASN.1) which has emerged from the ISO
efforts as a kind of lingua franca for the representation of
arbitrary data structures. The data types used in the SGMP
Management Information Base (aspects of network components to be
monitored) are the most restricted of the three proposals, confined
to integers and octet strings only. HEMS has the most extensive
Management Information Base and added some rather unique ideas such
as self-knowledge about what could be monitored so that a
device/unit/component could respond to a query asking "what can you
tell me about yourself and your operation and how is it represented?"
(!). CMIS/CMIP is probably the broadest in scope, but less precisely
defined at this point, with respect to information which should be
monitored. The draft RFCs referenced above relating to the CMIS/CMIP
concerning items to be monitored are still in the definition stages.

A point made strongly by the HEMS team was their concern that a
Remote Operations basis for CMIP may not scale well into a very large
Internet which needs to be monitored from a few central sites.
Remote Operations is a term used by ISO and means, roughly, what the
Internet community has long referred to as Remote Procedure Calls.
If each atomic action is a Remote Procedure Call, the HEMS team
argues that increasing Internet size and potential delays may vastly
constrain the amount and timeliness of information which can be
collected. The HEMS design uses, instead, a general query language
approach which permits more elaborate, multi-variable queries to be
formulated at the requesting site and processed at the responding
site(s).

Although it does substantial injustice to the very lucid and helpful
presentations by representatives of each of the network management
research groups, I have chosen to leave out much of the detail from
this report and move directly to the points of agreement which were
reached by the Committee.

3. POINTS OF AGREEMENT

(i) Future Internet development is a joint interest of the R&D
community, the vendor community and the user community.

[Editor's comment: The development of the Internet is now not only
dependent on research work, but on the hardware and software of
vendors selling to both commercial ("internet") and the research
environment ("Internet"). Moreover, the Internet users are not all
concerned with network research; many of the components of the
Internet are based on vendor-supplied and supported subsystems.]

(ii) We still don't have a common understanding of what
[Inter]Network Management really is.

[Editor's comment: We haven't tried to manage the Internet as a
collection of autonomous systems in an effective way, yet.]

(iii) We will learn what [Inter]Network Management is by doing it.

     (a) in as large a scale as is possible

     (b) with as much diversity of implementation as possible

     (c) over as wide a range of protocol layers as possible

     (d) with as much administrative diversity as we can stand.

(iv) There are more than HEMS, SGMP and CMIS/CMIP as potential
candidates:

     HEMS, SGMP, CMIS/CMIP [multiple profiles], NETVIEW,
     LANMANAGER, Network Computing Forum "Fat Document"...

[Editor's comment: The multiplicity of options is motivation for
coalescing the energy of the Internet environment around single short
and long term foci so as to make more substantial progress in really
understanding network management per point (iii).]

(v) Define the Management Information Base for TCP/IP suite NOW!

(vi) Seek a seat for IETF on ANSI, ISO and/or CCITT!!!

[Editor's comment: This may actually be feasible.]

(vii) Define a CMIS interface to any of the surviving network
management schemes so as to provide a migration path to ISO.

4. RESOLUTION AND CONCLUSIONS

In a dramatic act of statesmanship, Craig Partridge volunteered that
the HEMS proposal be dropped in favor of the other two efforts, SGMP
and CMIS/CMIP - IF THIS WOULD LEAD TO INTERNET-WIDE AGREEMENT ON A
NETWORK MANAGEMENT PLAN FOR THE SHORT AND LONG TERM.

A rationale for the long term was proposed, based on the assumption
that the ISO initiatives, and the U.S. Government issuance of the
GOSIP guidelines, would ultimately require at least the Government
users, and hence their vendor suppliers, to use ISO-based protocols
and tools. In this rationale, the Internet research community and its
vendors would "take the high ground" in network management by
implementing the CMIS/CMIP on top of the TCP/IP protocol suite and
deploy it widely for experimental use in the Internet.

Neither the ISO nor any other organization, including the Corporation
for Open Systems (COS) has anything close to the laboratory in large
that the Internet represents. By taking the initiative, the Internet
working groups can establish credibility based on experience which
will make it far more feasible to affect the evolution of the ISO
network management and other related efforts. The Internet community
will be able to speak with authority about problems with the design
or definition of CMIS/CMIP based on real implementation experience
and use, rather than solely analytic means.

In the short term, however, the Internet desperately needs tools to
apply to the operational management problems associated with its
rapid growth. Given the present state of advanced implementation of
the SGMP and its relative simplicity, the general agreement was that
SGMP (or its re-named successor, SNMP) should be quickly brought to
more complete specification for widespread implementation and use.

In short, the ad hoc committee recommends:

    1. In the short term, the Internet community should adopt and
    adapt the Simple Network Management Protocol (SNMP) for use as the
    basis of common network management throughout the system.

    (Rationale: The software is available and in operation.)

    2. In the longer term, the Internet research community and the
    vendors should develop, deploy and test a network management

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MEETING LOCATION: San Diego Supercomputer Center, UC San Diego

LOCAL ARRANGEMENTS: Paul Love, SDSC

MEETING DATE: 29 February 1988

AGENDA ITEMS:

    0900 Introductions and Objectives/Cerf

    0915 HEMS: Craig Partridge and Glenn Trewitt

    1030 Break

    1045 SGMP - Jeff Case

    1145 CMIP/CMIS - Amatzia Ben-Artzi

    1245 Lunch Break

    1430 TCP/IP and ISO: Politics, Technology, Penetration/Cerf

    1530 Break

    1545 Tradeoffs among alternate paths (Discussion)

    1700 Resolution of alternatives

    1730 Summary of conclusions/actions

    1800 Adjourn

REFERENCES

   The following reference material was provided in advance of the
   meeting. Note that some of the citations include informal
   descriptors (such as IDEA numbers or DRAFT letter codes), for
   example, IDEA-13 or DRAFT-AAAA. IDEA notes may be updated from time
   to time reusing the same number. The IDEA notes are the working
   notes of the Engineering Task Force. The DRAFT is a temporary
   notation and may not be meaningful for more than a few months.

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      Management System", IEEE Network magazine, March 1988.

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   CMIS/CMIP

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Protocol: Creation and Deletion Functions", November 1987.

(13) JTC1/SC21/WG4 N 482, "Proposal to extend M-Set and M-
Confirmed-Set to allow adding and removing values of a multi-
valued attribute", November 1987.

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